DOCUMENT RESUME

ED 030 326 EM 007 302

By-Torkelson, Gerald M.

Educational Media. What Research Says to the Teacher Series. Number 14.
Pub Date 68
Note-33p.
Available from-National Education Association, 1201 Sixteenth Street, N.W., Washington, D.C. 20036 ($.25)
EDRS Price MF-$0.25 HC Not Available from EDRS.
Descriptors-*Audiovisual Instruction, Computer Assisted Instruction, Dial Access Information Systems, Educational Objectives, *Effective Teaching, Filmstrips, Instructional Aids, Instructional Media, Instructional Technology, Instructional Television, *Media Research, Teacher Attitudes, Teacher Role, Teaching Skills, Video Tape Recordings

Designed to acquaint educators with research findings into the scope and uses of educational media and their impact on the teacher's changing role, this booklet discusses the shift in research from the consideration of media in general to the effects of specific media and stresses that in the teaching process the human tutor is indispensable. Teachers must understand the characteristics and functions of the various media before they are able to use them imaginatively as tools for teaching. They may then join their unique forces with those of educational media and explore how media materials may be selected in terms of learning goals and processes. Teachers and researchers should work together to improve the effectiveness of educational media. A bibliography is included. (SH)

ED030326

WHAT RESEARCH SAYS TO THE TEACHER

14

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Educational Media

Gerald M. Torkelson

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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It is impossible, of course, to provide a complete summary of research in any field in 32 pages. To help teachers further explore research findings, selected references are listed at the end of each booklet in the series.

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SIDNEY DORROS, *Series Editor*

Published by
NATIONAL EDUCATION ASSOCIATION
ASSOCIATION OF CLASSROOM TEACHERS

MARGARET STEVENSON
Executive Secretary

BRUCE P. ECKMAN
President 1968-69

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Educational Media

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ACKNOWLEDGMENTS

The author of this booklet, which replaces the earlier *Audiovisual Instruction* by Paul R. Wendt of Southern Illinois University, is Gerald M. Torkelson of the University of Washington. The manuscript was prepared with support from the ERIC Clearinghouse for Educational Media and Technology at Stanford University. The booklet was produced in close cooperation with the NEA Department of Audiovisual Instruction and profited from the suggestions and criticisms of Anna L. Hyer, executive secretary of the Department, and other members of the DAVI staff. Final interpretations, however, remain those of the author.

Copy editing was done by Mrs. Jane Power and editorial production by Mrs. Kirsten Carter, both of the NEA Publications Division.

EDUCATIONAL MEDIA

This publication is designed for teachers who are interested in the contributions that educational media make to the teaching-learning process. One of its purposes is to select from relevant research those suggestions which may have a direct bearing upon the teacher's use of media. Another purpose is to provide the teacher with a perspective about media which not only suggests the scope, depth, and applications of media to teaching, but also focuses upon accelerated changes in teacher roles which have resulted from the applications of media to instruction. Within this perspective must be comprehended also a growing emphasis upon the systems approach to analyzing and solving instructional problems, with particular emphasis upon media. By systems is meant the selection and orchestration of all the components relevant to a given learning situation. The system may be a large unit or macrocosm, such as an entire school system, or a subunit, or microcosm, of that school system. Educational media are a large part of the instructional system, particularly when the focus is upon self-instructional applications of media.

In this publication, research in media will be translated into practical terms, without direct quotations and, hopefully, without distortion of the research findings. This approach requires a mixture of humility, trepidation, and bravado, since the literature is mountainous and the findings are not always clear-cut or without contradiction. What does one say, for example, when the conclusion of much research in instructional television is stated as "no significant differences"? Certainly television cannot be ignored and will not be. What will be said in such cases will be a mixture of conjecture, fact, and experience, characterized more accurately as *qualified objectivity* than as *absolute objectivity*. Perhaps this qualified objectivity will be the general characteristic of this publication, since what is known absolutely about learners, about the learning process, and about media is limited.

Media seems to have superseded *audiovisual* as a standard referent for teaching and learning materials which have aural and visual characteristics. *Media,* in turn, is being replaced in some quarters with *instructional technology,* a term defined as including media as well as associated technological support systems. A na-

tional Commission on Definition and Terminology which suggested that the expanded audiovisual field be called *instructional technology* defined *technology* as "a systematic body of facts and principles related to a comprehensive, practical, and useful end. . . . The principles of effective teaching (pedagogy), for example, comprise a technology."

More recently, the term *media* has been used to refer to all modes of communication, including print and audiovisual forms and their accompanying technology. This is the definition used by a joint committee of the American Association of School Librarians and the Department of Audiovisual Instruction of the National Education Association in *Standards for School Media Programs*.[1] However, since teachers and prospective teachers are most familiar with printed materials, this publication will be concerned with nonprint media encompassing all of the older (audiovisual) types of teaching materials—such as the film, filmstrip, flat picture, recording, chart, and poster—and all the newer "media," such as computer-assisted instruction, programmed materials, television, and remote-access retrieval systems, including the relevant methods, systems, and hardware.

This booklet will be divided into four parts: (1) Media and the Educational Setting, (2) Understanding Media, (3) Utilizing Media in Teaching and Learning, and (4) Improving the Understanding and Use of Media.

MEDIA AND THE EDUCATIONAL SETTING

The total educational setting is an important factor to consider if one is to appreciate the larger dimensions of media in the teaching-learning process. Without this consideration a teacher may not look beyond any particular medium except as it satisfies an immediate need, with the result that the use of certain media may become incidental and superficial.

To provide wholeness of experience for the learner at all levels, it is important that the parts contributing to the larger experience be integrated and relevant. Similarly, media must be chosen carefully and must perform a particular function in the learning process. Such use of media requires a wide knowledge of what is available to assist learners, a thorough understanding of the quali-

[1] In preparation at the time this booklet went to press.

ties of the particular medium as it contributes to the learning experience, and an awareness of the contextual situation into which each medium is introduced.

The immediate society from which the learner comes tends to be his real world. Frequently there is a wide gulf between a learner's interests and classroom activities. There is ample evidence of this in student complaints about irrelevancies and boredom, with no apparent attempt by the teacher to improve the situation. Outside the school, learners are exposed to the effects of revolutionary developments in such areas as mass communications, travel, invention, and industrial production. As one popular writer has described it, we live in an "electric" age where the "medium is the message" and the impact of the technological revolution has developed a creature restless under the traditional linearity or the bit-by-bit sequential learning of the "print" culture. This context has tremendous implications for the use of media. It is imperative that teachers understand the full dimensions of media, both within and outside the school, so that greater "connection" may be made with learners in realistic terms, and so that the teacher may provide live, vibrant learning situations attuned to the cues of current society.

Might it not be natural to expect that a generation of learners who have "teethed" on television, Saturday movies, pictorial magazines, roadside advertising, and the use of pictorials and graphics in the "hard sell" outside of school should also learn through a wide use of media in the schools? Children learn to "read" the television screen and to interpret their visualized environments at an early age. As a consequence, it is not inconceivable that they may bring to school a visual sophistication which surpasses that of some teachers and may expect a similar environment in the school. For the teacher this fact of visual sophistication should suggest that more complex visual experiences may be introduced at an earlier age than was true a generation or so ago. Evidence shows that young children can learn language and spelling via the typewriter, can interpret still pictures, can learn via instructional television, and can use self-instructional materials, such as programmed instruction. Current study in media emphasizes research in the refinements of a given medium rather than raising the broader question of whether students at all levels can learn from

various media. In the same sense, there should be no question of whether a teacher should use a variety of media. The questions are rather *which* medium the teacher should select and *which* conditions should be used to enhance learning; this means it is necessary to refine the teacher's understanding of how learners interpret and use each medium.

The range of materials and devices available to the teacher seems ever to expand. The more traditional materials, such as motion pictures, filmstrips, recordings, flat pictures, graphics, and overhead transparencies, have been used successfully for many years. Greater quantities of all of these types are available every day.

If one were to characterize the changes which have occurred in research in these areas, one would note a movement away from a gross comparison of a given medium or a combination of media with "traditional" methods to more emphasis upon variables within media. There is already no lack of the latter type of research, particularly in motion pictures and television.

Motion pictures and television over the past decade have proved useful in stimulating interest, supplementing learning, aiding retention, and in influencing attitudes. Some research has proved the usefulness of film and television series as self-contained courses, utilized both in and out of school settings. Much less research over the same decade has been done with filmstrips, flat pictures, and recordings, although, as will be discussed later, research is being carried on which concentrates upon the improvement of elements within a given medium, such as in a filmstrip or within a picture.

Since there are physical limitations in this publication, the review of the use of the more common "audiovisual" materials will be brief. The greater focus will be upon more recent developments in media.

Programmed Materials and Computer-Assisted Instruction

The programmed instruction boom of the late 1950's and early 1960's continues at a slower pace, and less emphasis is placed upon the "teaching machines" which were characteristic of the early years of programming. The experience that many kinds of sequenced materials could be presented adequately through

"linear" or "scrambled" books seems to have influenced the decreased use of expensive machines. Today, programming focuses upon materials stored in computers and presented through various display devices, in addition to book-type materials. Systems of the computer type range from the simple keyboard controlled by the computer to the more elaborate system in which the computer program also activates the display of pictorial and aural materials to which the learner may respond through a keyboard response system and/or a "light pen" placed on the surface of a cathode ray tube. A computer control provides capabilities to adjust programs to the learner as he proceeds through the lesson, to record his responses for continuous analysis, and to learn about the effectiveness of materials through a systematic control of instructional variables. This latter advantage is normally beyond teacher-directed situations. The great value of programmed materials, whether in book form or in computer-assisted-instruction format, is that the teacher is freed from tasks which a carefully designed program may handle more adequately and consistently, without boredom for the teacher and without potential disadvantage to the student which may arise from the variableness of the teacher.

In many instances, effective programmed materials have released the teacher for consultation with individual students. Evidence shows that learners at all levels of intelligence and experience profit by programmed materials, that learning of some kinds is accelerated, and that retention of information is greater than under some teacher-controlled methods. This appears to be true when programmed materials are carefully sequenced, when they have been perfected through tryouts with a variety of learners, and when they contain devices for confirming and reinforcing knowledge. It is significant that the application of programming principles to learning materials, whether in book form or through machine-mediated systems, has freed the learner for the attainment of prescribed levels of behavior more in competition with himself than against performance levels of a group. Each learner proceeds to the next step in th program only after he has mastered the previous criterion level. Thus freed from the restrictions and pressures of learning in groups, the student may proceed at a rate more commensurate with his abilities and background.

Programmed materials are not, however, the panacea; there have been some problems. There is evidence of boredom where

materials are too minutely structured. The better learners, especially, may require materials with larger steps for acquiring information. Another problem is that the very process of programming is time-consuming and costly. There is also some question about how tightly material must be organized into subparts, since research indicates that some kinds of materials may be loosely programmed in prose form, using interspersed questions.

It is generally assumed to be an advantage that programmed materials allow the learner to proceed at his own rate—that he thus learns more than if he were paced in his learning by outside direction. There is evidence that although pushing the learner through a program may not be good, it should not be expected that self-pacing is a universal cure. It has been shown that students can learn programmed information in group situations where the information is presented via a television screen. Using specially prepared answer sheets, the learner responds to questions on the screen; after an appropriate interval, he compares his answer with the one which appears on the screen. Given such homogeneous characteristics as experience level and intelligence, it is possible to arrive at optimum pacing for group presentations, particularly with more sophisticated learners.

It appears that overt, correct responses are desirable for young children, but less critical for adults, and that, in general, some form of explicit response (overt or covert) enhances the value of most media of instruction.

There is concern about the effects of programmed instruction upon learner creativity. Some evidence suggests that creativity may be enhanced by self-pacing, by self-administration of the program, by learner choice of paths and materials, by flexible kinds of feedback, by rewarding deviant responses, by using large steps, and by using actual problems which must be solved in their entirety.

Film Loops

Another more recent development is the continuous film loop, silent or with sound, usually 8mm, available in cartridges with capacities of about four minutes to one-half hour showing time. These cartridges are easily inserted in the appropriate slot of the proper projector, and when the power is switched on, the film

appears on a rear screen built into the projection unit. Some projectors allow adjustments for both rear-screen projection and projection on a wall or screen.

An apparent advantage of the film loop is its ease of use by either the teacher or the learner. The latter may use the loop projector very easily in a carrel in the library or in any corner of the school that is convenient to a power outlet. As a self-instructional device, the film loop has the obvious advantages that it is easily handled, even by young learners, and that it can be used repeatedly for as long as the learner needs to view for complete understanding.

When used by a teacher, the film loop gives him greater control of the teaching situation by enabling him to show only a short sequence to highlight a part of the lesson, while he provides the necessary continuity normally built into long films. In fact, it may be that the content of the film of greater length could be more judiciously shown in segments, thus allowing more frequent checks on learner reactions and perceptions. Where parts of a lesson need emphasis or clarification during the course of presentation, the short length of a film loop provides opportunity to check audience understanding. On the other hand, it should not be assumed that use of longer films is unjustified, since for some purposes a longer film is necessary to develop the proper sequencing of ideas and to set the proper mood. Some research has shown that the use of a regular length film together with film loops from that same film has proved to be more effective than the regular film alone.

Remote-Access Equipment

Another recent development makes information readily accessible to learners through the use of telephone-type dialing or push-button instruments, which are usually installed in locations remote from the source of information. This equipment will play back recorded materials upon demand of the learner when he activates the appropriate sequence of numbers to start the playback mechanism. Most frequently this equipment retrieves aural materials. Less frequently, but completely within the capability of most remote-access equipment, the system provides retrieval of visual materials which may be stored as slides, films, or videotapes and are available to the learner via a television receiver which has

been built into the learning station. Typical installations provide earphones at each location.

The uses of a remote-access system are limited only to the kinds of materials that may be recorded as aural material, visual material, or a combination of both. Via these systems students have listened to lectures, discussions, dramatizations, and music; have responded to recorded tests; and have made up work missed through absence. The system provides opportunities for students to retrieve materials at considerable distances from the point of origination. In some public school situations, students from their homes have retrieved materials via the telephone by direct dialing. The advantages of remote-access information-retrieval systems are obvious. Less clear are the types of materials best suited for retrieval purposes, particularly in terms of information sequencing, cues for listening, and built-in techniques requiring learner responses.

Television

Instructional television has been used in the public schools for at least a decade or more. General experience has shown that the more completely a school system becomes involved in the use of television on a systemwide basis to solve a major problem, such as upgrading instruction, the greater is its acceptance and use for certain kinds of learning. There are still problems, however, in providing proper intercommunication between the learner and the television teacher. Mechanical systems which permit two-way conversation between the television teacher and students at locations remote from the teacher have not as yet provided satisfactorily the easy two-way communication necessary for the adjustment of the television presentation to the individual questioner. The pragmatic solution to this problem has been provision for "feed-back" in the classroom through techniques in which the regular classroom teacher prepares the learner to view the television program and to participate in appropriate follow-up activities. In some kinds of television programs it has been found that requiring overt response during the program has proved effective, particularly with young children engaging in simpler kinds of learning, such as rhythm exercises in music. By and large, however, television programs are treated in much the same way as a motion picture shown in the classroom—supplementary techniques are used for

directed observation. Research has shown that television programs are more effective when they pay attention to such details as clear organization, simplicity of presentation, opportunities for practice, motivating techniques, and knowledge of results. Also, it has been beneficial for the television teacher to direct learners to look at relevant parts of the television picture.

Television has proved effective as a demonstration magnifier. However, too wide a viewing angle and too great a distance from the television set interferes with the viewer's perception of details. As a transmission system to reach many learners simultaneously, and as an avenue for bringing expertise to the classroom, either to support that of the teacher or to fill a gap in the teacher's capabilities, television has proved its value. Taken as a whole, learners have learned as much via television as through classroom methods, at least when learning is measured on the kinds of evaluation instruments normally used. Much more research is needed, however, to capitalize on the unique contributions of pictorialized materials (including television) and to determine the best kinds of instruments to evaluate learning promoted via these means. The practice of using visuals for conveying information and details in the lesson and then testing on the verbal content exclusively has tended to diminish the importance of visuals in learning. In other words, learners who are tested mainly on the verbal content of a lesson will tend to pay attention to words and not to pictures. This suggests that the classroom teacher who uses television instruction or other types of visual media should analyze very carefully whether the testing procedures are appropriate for the type of learning medium used. To what extent should tests include pictorial materials to accentuate the content of those materials and to determine the level of learner observations?

Video Tape Recorder

Of more recent origin than the use of television itself has been the development of the portable video tape recorder, now within the cost limits of most schools. This equipment can virtually eliminate the problem of synchronizing broadcast television with class schedules. Simply by acquiring a video tape of the program, or by taping it during the broadcast for later use, the teacher may fit the program into the proper sequence of events. Video tapes have also

allowed repetitive use of programs where replay is necessary for fixing learning and for removing misperceptions. Used with a remote-access system, video tapes also allow individuals to view television programs privately. It might be predicted with some confidence that a growing amount of materials produced in television studios for group use will be used as material in self-instructional systems.

Another very important advantage of the video tape recorder is in its use for recording teacher and pupil performances. Its use for documenting teaching behaviors of student teachers is already becoming common. Experienced teachers also are using the video tape recorder for private analyses of their own performances.

In the whole area of teaching motor skills the video tape recorder has proved extremely useful. Evidence shows that learners acquire significantly different perceptions of themselves after viewing their performances on video tape. The opportunity to record learner performances is perhaps of even greater consequence for the teacher, for it enables him to develop expertise in assessing learner behavior and in developing efficient learning materials and experiences. Assessment of performance is too often done with paper-and-pencil devices. Researchers have judged that in measuring complex behaviors, paper-and-pencil measures have rarely proved definitive. The uses of video tape recordings and film records in testing have proved much more effective in measuring complex behavior.

New Roles for the Teacher

The potentialities for the schools of today are quite different than a generation ago because of the advantages of an up-to-date instructional technology. The advantages of the computer cited above make this quite evident. The computer can manage learning sequences, schedule students for given types of learning on the basis of a continuous surveillance of each student's performance, and provide "read-outs" and statistical analyses of learner development. These technological advances and the new arrangements necessary to accommodate them require of the teacher some new roles and insights not gained through the more traditional teacher preparation programs. What might the teacher do to accommodate and capitalize on these changes, and how might he

gain perspective about instructional technology? One way will be to organize his thinking about the functions of media in the teaching-learning process. Another will be to test the effectiveness of the newer technologies in the crucible of the classroom and in the context of independent study situations. Let's focus our attention on the functions of media first.

UNDERSTANDING MEDIA

Perhaps a logical beginning in understanding the relationships of media to teaching and learning is to establish several ground rules, or points of view, which may provide some insights. The first concerns the functions of media; the second, the characteristics of media as these relate to the particular problem of choosing a medium for a given learning objective and for a given learner.

Functions of Media

Media in their many forms provide the learner with "experience" about his "environment." The bulk of the learner's experience in school tends to be of a vicarious nature, except in some laboratory situations. Much of learning is presented as representations of real life, either because real life is inaccessible or because of the nature of the content, e.g., events which occurred in the past.

One approach to analyzing media potentials for instruction is to assume that teaching is essentially a process of communciation and that media may be regarded as avenues for communication. It is clear that the learner perceives the world only to the degree permitted by his senses and to the extent that his so-called "cognitive map" and general intelligence permit him to comprehend and organize what he experiences through those senses. For example, it is obvious that a myopic child with uncorrected vision will perceive fewer details of things he sees than the child with normal vision. The same may be suggested for restrictions in all the other senses. This means, of course, that the teacher must not expect that simply presenting materials in various forms ensures that the child has the same perception of the material as the teacher. The teacher must discover by questioning techniques what the learner does perceive; the questions should be so structured that to re-

spond, the learner must use the symbols or language he is expected to associate with the material. This practice with the associated symbols will provide insights for the teacher in analyzing learner capabilities and in setting learning sequences. Some researchers have reached the conclusion that while careful attention to the sequencing of appropriate materials for the learner is an extremely important task, the extreme individual differences that show up when learners are asked to respond individually to materials indicate that analysis of learners' capabilities is even more important. Teachers need to know a great deal about each learner's capabilities and levels of competence. The hypothesis has been suggested that lack of readiness in learners might actually be the absence of necessary prerequisite competencies and that lack of physical and developmental maturation may be due to the lack of relevant prior learning experiences. A great contribution of media is in providing these prerequisite experiences. In addition, the use of various avenues of instruction rather than the traditional symbolic means used so generously in public education may accelerate learning.

Characteristics of Media

The second area to consider for a fuller understanding of media are the characteristics of media themselves as communicative avenues.

The meaning of the term *media* is apt to be confused if we assume that it includes both the content to be learned and the equipment which conveys the content. For purposes of the following discussion, we will arbitrarily exclude equipment, since our concern is how learners react to the form of the content conveyed rather than to the equipment. In this connection, it is useful to distinguish among several relevant terms, which sometimes are accepted as synonymous with the term *media*. To some the distinction will appear to be arbitrary. It may be difficult to correctly determine the value of a field trip or school journey, for example, if it is classified as a direct and concrete learning experience and the media which are observed or used are not taken into consideration. Learners may observe and manipulate real things or observe abstractions, such as charts and graphs. The form of the medium that is observed will make a difference in learning. That

some precision is needed in such matters is demonstrated by the attempts of various authors to develop taxonomies or organizing patterns which provide a framework within which media characteristics may be analyzed.

The author, for example, has found it useful in elaborating upon this need to distinguish among three terms: *message*, *medium*, and *channel*. These distinctions are admittedly arbitrary; the major purpose for making them is to provide the teacher with a way to analyze media characteristics.

Message is defined as the content to be taught, interpreting the work *content* broadly as including knowledge, understandings, skills, and attitudes. In other words, the *substance* of anything the teacher hopes will be acquired by the learner, in whatever form, may be regarded arbitrarily as the *message*. The message might be information to be learned, skills to be performed, relationships to be understood, feelings to be acquired, or any of a variety of behaviors to be achieved.

The *medium*, in simple terms, may be regarded as the shape of the message, from the actual three-dimensional object itself, at one end of a scale, to the complete abstraction of that object at the other end of the scale, usually in some symbolic form. *Media* refers to the plural shapes of the message or to a combination of media. Some examples of media would be words, pictures, objects, two-dimensional projected images, symbols, and nonverbal signs such as pantomime.

Channel is interpreted as the vehicle (electrical, mechanical, or physical—a television system, a projector, a human voice box, or a recording and playback device) or the structure through which the medium is presented to the learner. Thus, the field trip or school journey referred to earlier may be classified as a channel, since it is merely the structure or administrative vehicle for getting the learner to the place where the media for learning are to be observed. The learning problem confronting the teacher on this occasion concerns the "shape of the message" or the medium to be observed on the field trip. The teacher must consider capabilities, prior experience, and other relevant individual characteristics of each learner as these relate to the relative concreteness or abstractness of the media to be observed by each learner. Having this kind of information, the teacher is in a better position to prescribe activities relating to the trip which will complement the

media involved and which will assist in overcoming problems each learner may have with a particular medium because of personal shortcomings.

A field trip to a museum to observe political cartoons of a bygone era focuses upon symbolic representations—such as caricatures—and consequently requires a different kind of background and build-up for the learner than a field trip to a museum where the learners are permitted to observe and handle the actual artifacts of some past civilization. It is true that handling artifacts may present a problem for the learner—comprehending the relationships of the artifacts to the civilization in question in terms of geographic location and the time separation between the era observed and the present. The problem of learning about the characteristics of ancient tools is likely to be easier, however, than interpreting the significance and meaning of the political cartoons, simply because the tools are concrete media.

These brief examples to differentiate among the words *message, medium,* and *channel* simply serve to underline the need for precision in focusing upon the avenues through which the learner must perceive the world about him. Recognizing that a learner's capabilities and experiences directly affect his ability to interpret the medium will help the teacher to appreciate that some kinds of media, such as pictures, may be easily understood by the learner because of their "realistic" nature, while others, more abstract, such as words and other types of symbols, may be completely beyond comprehension and experience levels. Even within abstract media, such as symbols, there are levels of difficulty for given learners. For example, mental retardates in one study who could learn words via teaching machines needed to write the entire word asked for and were unable to fill in missing letters. These retardates also learned the materials best in story form. For learners with higher mental capacities, and certainly for normal adults, it is generally sufficient to communicate at much more abstract levels. But even here people misinterpret one another's meanings. Learners with higher mental capacities do profit from the use of nonsymbolic media. The more experienced and intelligent learner can be expected to interpret media more fully than the less experienced and less intelligent.

The actual determination of which medium to choose is not easy. For learners who can read at a satisfactory level, for example,

it appears that one cannot generalize as to whether the medium should be a picture, spoken or printed words, or sounds. The well-educated adult and the more sophisticated student may learn equally well by hearing or reading. Any teacher serious about the use of media will face questions about the interactions of intelligence, reading ability, age, and content difficulty of the material as these influence the effectiveness of a given medium. These interrelationships are not clearly spelled out at the present.

One might conclude that placing media according to their characteristics on an arbitrary scale or continuum from concrete to abstract automatically means that as one proceeds towards the abstract one should assume also that, for all cases, the more abstract the medium, the more difficult it is for the learner to understand it. This may seem true when one considers the use of a photograph of an object and the use of a line drawing of that same object. One might expect that the photograph would be easier to understand. The crucial question in this instance, as in the selection of any medium, concerns the purpose for which the photograph was intended. If the intention is to observe internal relationships of parts, for example, a photograph of the external surfaces of an object will be less effective than a drawing of that object showing internal views. It appears that the important question the teacher must ask in selecting a photograph is, What are its unique capabilities in comparison to a line representation? There is evidence that visuals can improve the learning of manual skills and can facilitate the associative process. Where visuals do not serve a prescribed function, they may distract and interfere.

Where color is not significant to the object or message, it appears not to be crucial to learning. Where motion is not required, one might question the need for a motion picture. These types of problems are important, even though they seem to be within the realm of the obvious. More subtle areas of concern are the influences of such things in media as redundancy of information; the effectiveness of labels and cueing devices; the arrangement of items in a graphic; precision phrasing in film commentary; types of introductions and summaries; details of size and shape of objects; and the interrelationships of objects within frames of filmstrips.

One must conclude that there is actually little evidence that given media contribute to more or better learning than other

media under all circumstances; there is evidence that, given favorable conditions, pupils can learn from any instructional medium now available. Part of this problem is due primarily to the nature of research studies which have attempted to compare one medium with another. In this type of study, there have usually been too many variables which have been largely uncontrollable and have contributed biases and errors to neutralize the effects of the experimental variables. Within recent years much more emphasis has been directed toward the analysis of variables within a medium, such as the motion picture. For the teacher, this suggests that the more profitable approach to analyzing the effectiveness of media emphasizes less the general comparisons between media and more the learner reactions to a given medium. Some research in this area has shown that utilizing learner responses has been a valid method of developing more effective learning experiences. This is true in the development of programmed materials. In many cases, it is equally true in the improvement of filmstrips and motion pictures when learners are asked to analyze these media for ambiguities in the verbal and visual content.

Multimedia Presentations

Sometimes questions are raised about the effectiveness of multimedia presentations to learners in groups. The assumption for such use is that the variability among learners in a group requires the use of multimedia presentations as a kind of broad-gauge approach to teaching. To reach all learners simultaneously it is deemed important to provide something for everyone: something verbal, for those facile in verbal communications, and, for the less verbal, media that are less abstract. The term *multimedia* can mean either the use of media in a sequential arrangement or the use of various media presented simultaneously, as in the projection of several images on multiple screens. Multimedia teaching appears to have many merits and should not be minimized where there has been a prior determination that each medium has something to contribute for each member of the group. On the other hand, the simultaneous display of media and the sequencing of the presentation raises questions about competition for attention among media. Take the case of the simultaneous display of three

projected images on a divided screen. Even with proper directions, where should the learner turn his attention? Does the display of several images simultaneously cause competition for attention which may obviate the effect intended? Research in this area suggests that there may be competition among media which defeats the purposes of the presentation. Man's sensory mechanism seems to be selective in attending to the various stimuli which are presented simultaneously. Man also appears to make microsecond shifts among stimuli, attending to the stimulus which is the most relevant. Where there is a great similarity among the messages provided by the stimuli, there may be minimal interference. Where there is little relationship among the stimuli, there may be enough competition among them to interfere with learning. Research in this area is not completely definitive. Teachers may assist by systematically gathering student reactions to such multimedia presentations.

UTILIZING MEDIA IN TEACHING AND LEARNING

It is the purpose of this section to offer teachers a systematic way to raise questions about media as lessons are planned and carried out. The discussion will concern the role of the teacher, the meeting of learning objectives, and arrangements for learning.

The Role of the Teacher

Several results of a sophisticated instructional technology have been a growing use of self-instruction, an emphasis upon the improvement of group instruction, and a gradual change in the role of the teacher. Some teachers already are spending more time working with learners in self-study settings than they are in group teaching. More teachers are becoming members of teams that share responsibilities for group instruction, as "live" teachers in lecture-hall situations and as partners in the classroom with television teachers. Others are preparing media for individual study in programmed form for remote-access retrieval, and media for television programming. The concept of a teacher within the enclosure of four walls with thirty or so students is changing. It is predictable that the individual classroom, with one teacher inter-

acting with students in isolation from other teachers and students, will persist; but classroom grouping is becoming more frequently one among a variety of ways to organize for learning and teaching.

If the definition of *medium* given above is interpreted very broadly, it can be said that there are times when it becomes quite obvious that the teacher is the medium, the shape of the message. For example, it is well known that teachers develop idiosyncracies which are a form of nonverbal communication. Mannerisms, facial expressions, and bodily posturing convey signals to the learner about attitudes, points of view, and feelings of approval or disapproval. Every teacher becomes the filter system through which the message is conveyed to the learner. As a consequence, the teacher's role as a communicator cannot be ignored. It appears that in one dimension of learning, the permissive teacher may generate greater creativity and openness among learners and the authoritarian or autocratic teacher may generate an opposite condition. Under both types of teachers learners do acquire knowledge and facts. These examples emphasize that the teacher needs to examine his role as a communicator and the influence of that role upon the learner. What is it about a teacher that is unique? Where the purpose of a lesson is to have the learner acquire information that is adaptable to recording in aural and visual form for later retrieval by the learner, there is some question about the need for a teacher personally to convey this information. Perhaps teachers are not efficient information givers, particularly when it is necessary to repeat the information a number of times. Every teacher knows that successive classes in a given subject during the same day tend to receive variations of the same information from him.

How might the teacher have opportunities to exercise unique qualities? One way is to present content in ways which utilize the advantages of particular media. Given the present capability of equipment that can record materials in audio and visual forms, the teacher has the option of providing information and expository type materials in forms which release him for more personal contact with each student. As more independent study is urged in schools, the teacher will be required to face this option more frequently.

Another way for the teacher to provide time for uniqueness is to become thoroughly familiar with "packages" of materials already

available elsewhere. Given ample supplies of materials which have been prepared by experts and tested with learners, the teacher would be much freer to direct learning situations which demand his presence.

Experience in training teachers to produce programmed materials has proved that the process of specifying objectives and organizing information and experiences has a positive influence upon a teacher's general effectiveness. This role in programming will expand with the growing use of media and with situations where the teacher will be asked to play a larger part in meeting individual needs of learners.

Opportunities must be provided for the teacher to determine unique roles, but opportunities must also be provided to determine those qualities of media which are unique. In this way the teacher and media together may provide for the learner the best and most effective experiences possible.

MEETING LEARNING OBJECTIVES

To be used effectively, media must be appropriate for learning objectives. This requires a specification of learning goals in terms that are explicit descriptions of learner behavior, and that are observable and measurable.

Teaching Attitudes

In the affective domain, learning goals must be expressed as observable changes or shifts of feelings in learners. While this is a difficult area in which to specify objectives and to develop measures of change, some research has shown that the careful design of a motion picture to meet a specific purpose has resulted in a change in learner attitudes after only a short exposure to the film. This result contradicts the generally held conclusion that attitude change occurs in learners only after long and subtle exposure to teaching materials which reinforce biases or which wean the learner from long established feelings. In other words, any sudden or short term attempt to change long held beliefs was felt to be less effective than the gradual process of influencing the learner over a long period of time. The dramatic change in performance of learners after short exposure to a film may have been related to

the fact that the film was designed to change the audience's specific beliefs. Many films intended to change attitudes have been aimed at a general audience with rather loosely defined beliefs. Although the single study did not conclusively prove the influence of film upon attitude change, it does suggest that the teacher select a medium for qualities which will meet as closely as possible the needs defined.

Research has shown that attitudes can be influenced positively by various media, especially films. For young children who have not yet formed the prejudices and biases of adults, the film offers an excellent way to shape desirable attitudes and beliefs. For older learners, including adolescents, the task is more difficult and a combination of emotional appeal and reason is important. On the other hand, the emotional effects of dramatic or traumatic types of films upon learners is well known. Some of the more traumatic films, such as gruesome scenes from automobile accidents, evoke effects which sometimes are of long duration. In general, media research has shown that emotional involvement of some kind in the experience is important and that redundancy or reinforcement of the experience is necessary for lasting changes in attitudes.

Techniques for the teacher who is using media to develop attitudes would include a nonprejudicial introduction to the topic and a selection of media with possibilities for emotional involvement. In discussion of relevant issues, the teacher should avoid inhibiting student expression through his own biases or subtle expressions of approval or disapproval. A climate of objectivity and openness should be the goal. Crucial to the whole problem of selecting media for attitude change is the consensus developing among researchers that a learner's existing attitudes and values are among the most critical factors in determining procedures and in choosing appropriate media.

Teaching for Understanding

The major purpose of teaching for understanding may be expressed as the development of learner ability to see relationships. This kind of learning can be structured more exactly than affective learning. The time-worn sequence of introduction, presentation of the medium, and follow-up is still applicable. Current research in

media, however, indicates that the teacher should focus upon the explicit statement of behavioral objectives. Instead of stating objectives in general terms, such as "understanding 'due process of law,' 'the process of osmosis,' 'the causes of the Civil War,' 'the water-cycle,' or 'our community helpers,' " the statement should be narrower in scope. "Understanding the water cycle" would be stated as "explaining the steps in the water cycle" or "explaining the meaning and function of evaporation and condensation."

Applying this explicitness, one would select media to meet *specific* needs, e.g., to supply particular information, to show exact procedures, or to pictorialize relationships or details. Film research has shown that the more specific the film can be made to the task prescribed for it, the greater is the possibility for learning. This point was reinforced by recent research in which filmstrips and films in a science area were improved through student reactions. One of the findings was that verbal explanations and pictorial materials could be made more explicit, with significant increases in learning.

When the task has been to understand phenomena, processes, and other interrelationships, it has been found that understanding has been enhanced significantly by the use of explicit introductions, directions, directed viewing of pictorial images, overt responses, and reviews of the content presented.

Content which can be organized into expository form lends itself well to self-instruction. As was discussed earlier, students have learned certain types of content in minimal time when that content has been programmed. In one study, in which learners were asked to derive principles from such materials independently of the teacher, it was shown that the method without the teacher was less effective than the procedure in which the teacher verbalized the principles first and then asked the learners to practice the examples.

In choosing materials for developing understanding, it would be wise to select materials which are well organized and which have potential for provoking questions. An open-ended film would be such a material—a film designed for discussion, which documents pertinent circumstances of the problem but offers no solutions.

On occasion, a particular motion picture, filmstrip, or still picture may seem too elementary or too difficult for the audience involved. This difficulty may be partially overcome by the way the

group is prepared to use the material. Asking the learner to interpret what he sees and hears is a basic approach to using media for developing understanding.

When concepts to be taught are difficult or complex, research supports a second showing of a film, especially when the material is self-contained and does not lend itself to interruption, like a sound film. With carefully prepared guides as supplements, coupled with a thorough discussion between showings, for example, it is generally not necessary to view a complex film a third time. A need to stress content not emphasized in the earlier viewings might be justification for a third showing.

Learners empathize easily with motion picture content because of motion and other filmic techniques. Static materials, such as still pictures and graphics, present another problem. By their very nature they do not generally have built-in attention getters, as does a film with motion. The task of the teacher, therefore, is to plan attention-getting procedures for static materials. The technique of asking for student interpretations and reactions appears to be very effective. Student use of such materials may be directed through supplementary materials, such as check sheets and questions.

The need that all see simultaneously the details of any still picture used for group instruction is obvious. Yet teachers persist in holding small pictures in front of groups without realizing that very few students can see the details. The only solutions seem to be to project the material, to pass the pictures among the students, or to provide enough copies of the pictures so that all can view simultaneously as the teacher directs the observation and analysis. Among these, the process of passing a few pictures among students while the teacher continues to talk about succeeding pictures is a very poor technique. Not only does the teacher set up competition for himself, but the student is likely to have difficulty in recalling the directions for each picture if dependence for directions is completely upon teacher comments. To overcome these conditions the pictures must be made independent of the teacher—packaged, as it were, to be used by each individual, in a group or alone. This preparation of pictures for independence from the teacher points up the desirability of certain kinds of materials which the teacher cannot normally provide. This is not to say that the teacher has no important role to play, but to suggest

that teachers need to examine rather carefully whether the materials and techniques they use reinforce or interfere with learning.

Teaching Skills

In teaching skills, the psychomotor domain, much the same procedures are applicable as in teaching for understanding. This is true at least of identifying the skill to be achieved, of the steps for achieving the skill, and of stating reasons why the skill is important to acquire. For refinement of performance, however, practice is very important to fix procedures. Here the use of the video tape recorder has proved its worth. Confirming results from early motion picture studies, evidence proves that using the video tape recorder to provide the learner with a moving image of himself performing a particular skill has accelerated achievement and has influenced positively his self-confidence and self-image. Already special areas in schools are being equipped for accelerating skill development, with emphasis upon instantaneous recording and playback equipment. The advantages to physical education, speech, drama, and other areas requiring motor development need no elaboration.

Arrangements for Learning

It is predictable that teachers will become more involved in making decisions about the use of open, changeable learning spaces, and will be asked to specify what spaces are needed for certain kinds of learning tasks. Many schools today are being constructed upon various kinds of modular plans which open the interior spaces to relatively easy alteration. Little research has been done, however, to determine whether the spaces provided offer the best environment for particular kinds of learning tasks. How might the teacher help in this matter?

One way is to keep a record of the adequacy of certain types of spaces for certain kinds of learning and then to channel this information to the persons responsible for designing learning spaces. In this way the program requirements of the school will dictate space needs rather than the space arrangement's dictating the program.

Another way to determine the efficiency of learning spaces is to analyze teaching-learning functions—exposition, investigation, performance, and independent study—as bases for specifying space requirements. The result would be more definitive suggestions to school facilities planners about the kinds of spaces and facilities needed to support the use of media. The use of these bases may prevent arguments about philosophies or goals of education, because each of the functions mentioned is common to all philosophical positions.

Exposition encompasses the expository or explanatory process typified by lectures and discourses by the teacher. Exposition is not limited to the teacher, however; it may be provided through books, films, graphics, and any other form with primary capability to give information and explanations. The question to be answered by the teacher is, What facilities need to be provided in the school structure to support the expository function? If a lecture hall for large group instruction is determined to be important, how should it be designed and what should it contain to support exposition? Such commonplace items as screens, darkening facilities, display surfaces, light control, air-conditioning, and control systems to minimize the intrusion of the mechanics of instruction are some of the factors to be considered.

Investigation is defined as the involvement of the student with materials and activities through which, alone or with other students, he may investigate phenomena and relationships, as in a science laboratory. This may also include interactions among individuals in conflict, as in role playing. For examining human interactions it may be that social studies facilities should be equipped for dramatic presentations of various types. Generally speaking, the investigative environment must provide easy access to various kinds of supplementary materials. In addition to the traditional laboratory equipment of the sciences, for example, adequate planning should provide access to materials which reinforce investigation, such as film loops to show lab processes. At each lab station, there might be remote-access equipment for retrieval of aural and visual materials stored at a centralized location. The teacher in this environment, freed from repetitive activities such as giving directions—which could be easily and uniformly handled by recorded forms of communication—could devote more time to individual learners.

Performance refers to those functions requiring skill in certain types of motor activities. The teacher's role would be to categorize the skills required and to suggest proper facilities. For example, the video tape recorder would have important use in physical education, drama, speech, typing, arts and crafts, and other areas where the study of the recording of student and teacher behaviors could increase improvements in performance. In specifying facilities for performance, consider whether several activities can occur in the same location if it is properly equipped or whether each activity must have separate facilities.

Independent study is the private affair between the student and various types of media, usually provided in a learning resources center or library or at a remote learning station. The major requirement for independent study facilities is ease of access to all sorts of learning materials, primarily through remote-access equipment, but also in shelved form in the learning center. Thus, film loops would be checked out like books and each learning station would be equipped for remote retrieval or for certain types of projection or play-back equipment to be operated by the student at the learning station. The developments in information storage and retrieval make it probable that the learner will also be able to retrieve various printed materials located in a central library some distance from his learning station, even miles away.

Among the four functions mentioned, *independent study* should be regarded less as a separate type of function than as a function which may occur in each of the other three.

These teaching-learning functions are reviewed here as a way of focusing on the exact facilities needed for the performances of certain functions. Engaging in such review will also lead teachers to a more careful specification of the areas of the curriculum most appropriate for certain functions. It is possible to organize the content of a given unit—or of a whole curriculum, for that matter —in terms of those portions which lend themselves to exposition. Once this is done, it becomes possible to determine the best media for exposition, whether it be a teacher lecture or some form of recorded material. The same approach could be used to determine the parts of the curriculum which lend themselves to investigation, to performance, and to independent study.

Research has been done to find ways to reduce construction costs of schools and to provide changeable interior spaces. Very

little research of a definitive or systematic nature has been done to determine the interactive effects of space and program as these interactions affect learners. This is another area in which teachers must become involved if the use of media is to be refined. The physical environment within which learning occurs does influence behavior. Note the differences between students in carpeted areas and students in hard-floor areas. Even teachers have relaxed and become more open in environments conducive to informality.

IMPROVING THE UNDERSTANDING AND USE OF MEDIA

This brings us finally to a consideration of how to improve understanding of media and their uses. Teachers and researchers in media might well form a partnership, sharing techniques which may be of help in two areas: understanding the applications and limits of media and understanding more about learners.

In order to understand more about media, it is desirable that the teacher maintain an analytical attitude toward their selection and use. Instead of accepting statements about the effectiveness of media at face value, the teacher should attempt to judge media against some systematic format. Such a format can be found in the procedures for developing programmed materials and for arriving at the sequential steps necessary for effective instruction. Both procedures depend, as a first step, upon a careful specification of what is to be learned. Some researchers in media recommend that to make learning specific it must be operationalized, that is, stated in some form which can be observed and which is replicable. Media have the advantage of providing avenues for learning which are replicable, thus offering a standardized method of studying the interrelationships between media effectiveness and learner behavior.

How might a learning objective be written in operationalized terms? Basically, a statement is required which spells out behavior in a way that is observable. For example, instead of stating a learning objective as "knowing the rules of punctuation," the teacher might say, "Write a 10-statement paragraph using periods, commas, semicolons, colons, quotation marks, exclamation points, question marks, and apostrophes." This kind of performance is observable and is operationalized. It requires a product which can

be judged on the basis of specific performance standards. Where various media are used to teach punctuation, the effectiveness of each medium can be evaluated against the operationalized objective, and the effectiveness of the medium for each learner can be observed.

Once the objectives are made specific so that they are observable, the next step is to determine the prior experience of the learner and his predisposition for certain kinds of media. This also requires that the structuring of knowledge and the sequencing of its content correspond with learner characteristics. In the development of programmed materials, this appropriateness of the material to the learner's characteristics is determined by trying out the material in successive trials with different learners and making the modifications dictated by student responses. For most teachers this procedure is beyond their hopes, since time is not generally allowed in the teacher's schedule for such an analysis. This technique, however, is a valid way to improve media and to discover more about learner reactions.

The uniformity of instruction available through certain forms of media, particularly those that are self-contained, allows opportunities to discover more about learners. By observing different students interacting with the same material, the teacher may gain insights about the appropriateness of media for different learners. To expand knowledge about media, some standard techniques are to alter aspects of the medium itself; to vary introductions and summaries; to require different kinds of learner responses; to use media in combination; to use shorter or longer versions of the medium; and to intersperse or refrain from questions.

It is becoming more apparent that for the analysis of media applications to learning, it will be necessary to provide either qualified personnel with responsibilities for this task or released time for teachers. Released time for teachers is a valid suggestion, because the planning of self-instructional sequences requires seemingly inordinate amounts of time. Perhaps the proper approach to this issue is not to talk in terms of released time, but to urge redistributions of the teacher's time, questioning the limited effectiveness of group methods for meeting individual needs. It is unrealistic to expect teachers to develop ungraded, continuous progress approaches to learning without adequate preparation time or sufficient support in obtaining prepared materials and in

creating those which must be unique. Progress towards individualizing instruction requires in addition well equipped learning resources centers and qualified support personnel who may assist the teacher not only in the design and sequencing of messages for self-instruction, but also in the creation of proper learning facilities. Such support will also take out of the hands of the teacher the details of producing graphic, photographic, and other materials requiring production skills. To provide anything less can be predicted to block acceleration toward the greater individualization of instruction.

CONCLUSION

This discussion has centered primarily upon the many roles of the teacher resulting from wider applications of media to the instructional program. Associated with these newer roles are greater demands upon the teacher to determine unique contributions of media, to design new arrangements and sequences for learning, to evaluate the effectiveness of media by observing and documenting learner reactions, and to prepare or assist in the preparation of appropriate materials. It was pointed out that some of the teacher's traditional tasks may be handled satisfactorily by certain kinds of media, particularly in the expository process. Considering the potential sophistication of a computer, it is possible to have programs and systems for instruction which may be completely independent of the teacher, except as the teacher may become involved in preparing materials for the computer.

These signs and predictions sometimes cause teachers to fear that they are about to be replaced by machines. For example, research has shown that such terms as *instructional technology, machine tutor,* and *tutor text* have elicited negative reactions from teachers.

To allay some of these fears and to provide perspective, the point should be made that while it is true that some kinds of prepared materials have proved effective alone in providing for certain kinds of learning, the teacher offers qualities which no machine can supply. These are the human touches so necessary for developing rapport, for encouraging learners, and for helping them to test ideas in teacher-student interchange. The teacher

must also supply expertise in master planning, where balance must be maintained between human and nonhuman experiences for learners. To assume this role of leadership, however, it is necessary that the teacher know the contributions of media well, develop expertise in the selection and evaluation of media, and relinquish those roles where evidence indicates that other forms of communication result in better learning. Thus released from chores and unrewarding activities, the teacher will acquire more time to exercise the unique, humanistic qualities which help the learner become more than an automaton responding to impersonal learning systems. In the long run, both the teacher and the student will benefit from this careful delineation of the unique qualities that the teacher and media each may contribute to the teaching-learning process.

What might the future be for the teacher, the learner, and the school in general? The literature on media suggests two options: a *machine-independent* school system or a *machine-dependent* school system.

The test of the *machine-independent* system is to remove all of the machines (i.e., projectors, recorders, computers, teaching machines) and observe what happens to the program. If the program and its activities are not measurably affected by the removal, the system is regarded as dependent primarily upon the teacher as the decision maker, authority, and major dispenser of wisdom. In other words, machines in this system are, by virtue of use, incidental, not necessary parts of the basic program for influencing learner behavior.

In the *machine-dependent* system, the removal of the machines would result in a collapse of the basic structure. In other words, the machines carry part of the teaching load and have equal importance with other components in the system. Typical of machines that can do this are those which support self-instruction. The teacher is a necessary component in this structure but assumes roles more concerned with instructional planning, the preparation of materials and learning experiences, and the evaluation of student progress. The teacher in this system has a great deal of importance, as a "mediated" teacher, exerting a growing proportion of influence for certain kinds of learning through printed and recorded forms of instruction. The basic problem confronting such a system is achieving balance between the teacher and machine-

dependent avenues for learning. The evidence from research is that machine-dependent systems have proved their worth for providing kinds of learning which are adaptable to nonteacher forms. The future need is for a greater clarification of the teacher's unique contributions and roles.

Logic, experience, and research results point to a growth of machine-dependent systems. The hope is that teachers will assume a dominant role in giving it direction and in helping to provide the ultimate for each learner through the proper balance between human and nonhuman forms of communication.

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